On the Rating of Chronometers. By J. Hartnup, Esq.

At the Liverpool Observatory, Mr. Hartnup has been recently engaged in discussing the sea-rates of nearly two thousand chronometers, for the purpose of ascertaining the average errors for voyages of different lengths. On comparing the rates at sea with the rates of the same chronometers obtained at the Observatory, the importance of attending to the thermal correction has manifested itself more strongly than ever; and, in addition to this, the rates are often found to increase or diminish with such regularity from one month to another, that a correction for this may also be very frequently applied with great advantage. Mr. Hartnup has, therefore, been induced to make considerable alterations in his method of testing and giving the rates of chronometers, with the view of ascertaining the value of these corrections more accurately, and of rendering the application of them more simple.

The following is an example:—

From the week ending November 1, 1862, to the week ending January 24, 1863, the temperatures to which the chronometer was exposed were 55°, 70°, 85°, 70°, 55°, and so on in succession; it, therefore, requires five weeks for a complete series of rates in the above-named temperatures, and these were obtained between October 25 and November 29, the observed rates being as follows:—

	Temp.	Rate.
	°	s
Nov. 1	55	+0·9
8	70	+0·4
15	85	−0·7
22	70	+1·6
29	55	+2·1

Now the rates in 55° for the week ending November 1 being $0^{s}\cdot9$ gaining, and in the same temperature for the week ending November 29 being $2^{s}\cdot1$ gaining, the difference is $1^{s}\cdot2$, which, divided by 4, the number of intervening weeks, gives $0^{s}\cdot3$ for the weekly increase of gaining rate.

We, therefore, have for November 15:—

			s		°
	Mean daily rate	losing	0·7	in	85
From Nov. 8 and 22	,,	gaining	1·0	in	70
From Nov. 1 and 29	,,	gaining	1·5	in	55

And weekly acceleration of gaining rate 0·3

With the above data the error on Greenwich Mean Time has been calculated for each week subsequent to November 15, by adding $0^{s}\cdot3$ × by the number of weeks to that mean daily

rate which corresponds with the temperature to which the chronometer was exposed, multiplying the sum by 7, and adding the amount thus obtained to the error for the preceding week. That is, Calculated Daily Rate = Daily Rate Nov. 15 for same temperature + $0^s{\cdot}3 \times$ number of weeks since Nov. 15. For example, for the week ending Jan. 17, temperature 70°, Calculated Daily Rate = $1^s{\cdot}0 + 9 \times 0^s{\cdot}3 = 3^s{\cdot}7$, which, multiplied by 7, is = $25^s{\cdot}9$, and Calculated Error for Jan. 17 = Calculated Error for Jan. 10 + $25^s{\cdot}9 = 0^h\ 3^m\ 58^s{\cdot}1 + 25^s{\cdot}9$ = $0^h\ 4^m\ 24^s{\cdot}1$.

In this way the following Calculated Errors in Greenwich Mean Time have been obtained, and compared with those found by observation, from November 22, 1862, to January 24, 1863, and the Observed — Calculated Errors range from $+\ 3^s{\cdot}8$ to $-\ 8^s{\cdot}5$ for the eight weeks subsequent to the last observed error and rate used in the calculation.

	Temperature to which Chronometer was exposed.	Error on G.M.T. Calculated.	Error on G.M.T. Observed.	Obs^n — Cal^n.
1862.		h m s	h m s	s
Nov. 22	70	0 2 12·4	0 2 14·5	+2·1
29	55	2 27·1	2 29·4	+2·4
Dec. 6	70	2 40·4	2 42·6	+2·2
13	85	2 43·9	2 47·6	+3·7
20	70	3 1·4	3 5·2	+3·8
27	55	3 24·5	3 27·1	+2·6
1863.				
Jan. 3	70	3 46·2	3 47·5	+1·3
10	85	3 58·1	3 57·6	−0·5
17	70	4 24·0	4 18·9	−5·1
24	55	0 4 55·5	0 4 47·0	−8·5

If the corrections for temperature and acceleration of rate had not been applied and the $0^s{\cdot}7$ losing rate found for the week ending November 15 had been used, then, by exposing the chronometer to a temperature of 55° for the eight weeks, the Greenwich Mean Time by the chronometer would have been wrong nearly four minutes; and if, on the other hand, the rate for 55° had been used and the chronometer exposed for the eight weeks to 85°, the error would have been only a few seconds. In the former case the defective thermal compensation and acceleration of rate both tend to increase the error, while in the latter they nearly neutralise each other. It is, therefore, not surprising that we frequently hear of so much difference being found between the sea and land rates of chronometers; nor can it be expected but that we meet with very discordant results in attempting to find the average error to which chronometers are liable at sea. The average error for a voyage of eight weeks, found from data given at foreign ports, is a little under one minute; but while the

Greenwich Time shown by ten per cent of the chronometers from which this result is obtained, is found to be nearly free from error, there are also ten per cent in which the average error is upwards of four minutes.

On the Parallax of certain Stars. By M. Auwers.

(*Extract of a Letter to the Astronomer Royal, dated Gotha,* 1863, *Jan.* 16.)

Since I communicated to you the notices on the Parallaxes of two stars, I have made an examination of Johnson's observations of 61 *Cygni*, in the hope that the Oxford heliometer, if the observations made by it are treated in such a manner as to make the known systematic faults of heliometer-distances exercise the least possible influence on the results sought, may give a decisive voice for one of the two irreconcileable values for the Parallax, namely Bessel's of $0''\cdot370$, and Struve's and mine of $0''\cdot553$.

I have taken as the subject of calculation the quantity $0''\cdot705 \times$ dist. of 61 *Cygni* from B.A.C. 7320 — dist. of 61 *Cygni* from Lalande 41030, instead of the distances themselves, or their immediate differences; my hopes, however, have not been confirmed.

The whole series of observations gave the Parallax $=0''\cdot426$; the residual errors, however, are of such a nature that we cannot look upon the observations as sufficiently represented with this value of Parallax. Still less is this the case, if, instead of using the annual variation of the above-given differences that follows from the measures themselves, we assume that which follows with greater security from the meridian observations, with which the Parallax comes out $0''\cdot402$. But if we calculate separately the observations of the eleven first months (40 in number), and those of the remaining seven months, we obtain from the former the Parallax $= 0''\cdot526$, from the latter only $= 0''\cdot192$; the first of these values agrees very well with Struve's and mine, whilst the second departs materially from all determinations, and seems to show that the observations made after June 1853 are affected with some systematic error.
